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Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

Let $y^2 = 4a(x+a)$, $(y \cos \beta + x \sin \beta)^2 = 4A(x \cos \beta - y \sin \beta + A)$ be the confocal parabolas.

$$(1) \ y^2 - 4ax - 4a^2 = 0.$$

$$(2) \ y^2 \cos^2 \beta + x^2 \sin^2 \beta + 2xy \sin \beta \cos \beta - 4A x \cos \beta + 4A y \sin \beta - 4A^2 = 0.$$

Calculating the invariants for (1) and (2) we get

$$\Delta = -4a^2, \quad \Theta = -4a(a + 2A \cos \beta), \\ \Theta' = -4A(A + 2a \cos \beta), \quad \Delta' = -4A^2.$$

The condition is given by $\Theta^2 = 4 \Delta \Theta'$.

$$\therefore 16a^2(a + 2A \cos \beta)^2 = 16a^2 A(A + 2a \cos \beta).$$

$$\therefore a^2/A^2 + 2(a/A) \cos \beta + 4 \cos^2 \beta = 1, \quad a/A = -\cos \beta \pm \sqrt{1 - 3 \cos^2 \beta}.$$

$$\therefore \cos \beta > 1/\sqrt{3}.$$

$\therefore \beta$ lies between $54^\circ 44'$ and $125^\circ 16'$, and also between $234^\circ 44'$ and $305^\circ 16'$.

If $\beta = \frac{1}{3}\pi$, $a = \infty A$ or $-A$.

If $\beta = \frac{1}{2}\pi$, $a = A$ or $-A$.

If $\beta = \frac{2}{3}\pi$, $a = A$ or ∞A , etc.

CALCULUS.

282. Proposed by S. G. BARTON, Ph. D., Clarkson School of Technology, Potsdam, N. Y.

A rectangular beam of length l and width w is taken horizontally from a hall of width b into a corridor at right angles to the hall. Find the width of the smallest corridor into which it can be taken.

Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa., and J. M. ARNOLD, Crompton, R. I.

Let $ABCD$ be the beam, the corner A against the hall wall, the corner B against the corridor wall; the point P of the beam against the corner of of meeting of hall and corridor.

Let $AB = l$, $BC = w$, $x =$ width of corridor, PQ the portion of the width the corridor under the beam, QR the remainder of the width.

Then $PQ + QR = x$, $AQ + QB = l$, $ER = b$, $\angle BAE = \theta$. Then $PQ = w \operatorname{cosec} \theta$, $AQ = b \operatorname{cosec} \theta$, $QR = (l - b \operatorname{cosec} \theta) \cos \theta$.

$$\therefore x = w \operatorname{cosec} \theta + (l - b \operatorname{cosec} \theta) \cos \theta \dots (1).$$

Differentiating (1) we get, $w \operatorname{cosec} \theta \cot \theta + l \sin \theta = b \operatorname{cosec}^2 \theta$.

$$\therefore w \cos \theta = b - l \sin^3 \theta \dots (2).$$

The value of θ from (2) in (1) gives the width x required.

$$(2) \text{ becomes } l^2 \sin^6 \theta - 2bl \sin^3 \theta + w^2 \sin^2 \theta + b^2 - w^2 = 0.$$

Also solved by J. E. Sanders and the Proposer.